Electronic Flight Bag

Enabling a Safe and Efficient Global Air Transportation System

Boeing Crew Information Services

Jeppesen

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Boeing Commercial Airplanes

What is an EFB ?

EFB is a system comprising hardware and software that provides:

• Flight Crew access to emerging electronic flight operations data, general purpose computing and communications

• Replacement of many of today's paper documents

• A range of implementations spanning portable electronic devices up to installed certified integrated systems

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Why Implement EFB?

- *Today*, virtually all documents are authored electronically, yet distributed with paper. Aircraft operations are documented and supported extensively using paper.

Today

With EFB

Airplane Manuals* - 77 lbs/ 35 kg

* Typical 777 manual set.
  Does not include maintenance logs.

QRH

Goal: Eliminate paper and associated revisions required to operate an airplane

Airline Requirements for EFB?

Based on Airline Inputs

System Requirements
- Open Architecture

- Simple, intuitive operation

- Data accessible - all phases of flight

- Range of implementations (portable through installed)

- Replace existing paper products

- Provide rapid updating

- Improved Communications - AOC to CPDLC

- Common implementation across Airline fleets

- Minimize training footprint

- Growth and flexibility to expand with Airline needs

- Low Cost

EFB Implementation

Specifying Systems that are:

• Modular and Scaleable - Multiple entry levels

• Operate with Windows and Linux

• Provide Connectivity with ACAR's, SATCOM, Connexion etc

• Integration with existing Avionics and Systems

• ARINC 763 Compatible

• Include Video Surveillance in baseline

• DO-160D and RTCA DO-178B Level C

• Data distribution via secure internet (MyBoeingFleet.com)

• Pilot User Interface - Human Factors compatible

Boeing/Jeppesen scaleable EFB solutions provide multiple entry points and migration paths between portable and/or installed options.

Early adopter - 2002

High End Adopter – 2003/4
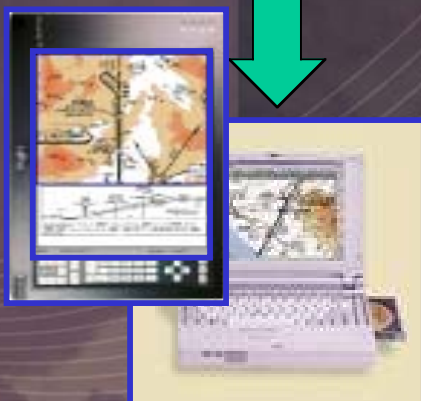
Transition

AND/OR

•Non-Essential Applications Only
•Restricted number of Applications
•Restricted phases of flight
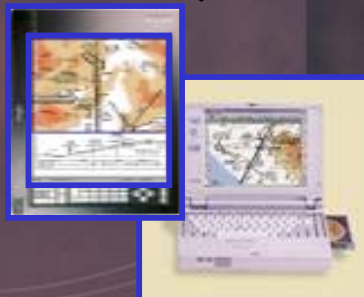
•Essential & Non-Essential Level Applications
•Unlimited number of Applications
•ALL phases of flight
•Supports: laptops, Keyboards,printers, CCD

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Early adopter - 2002

High End Adopter – 2003/4
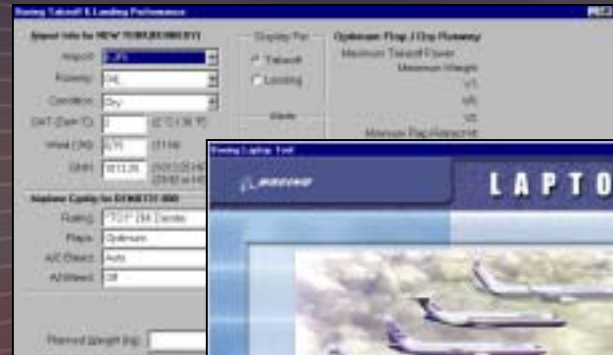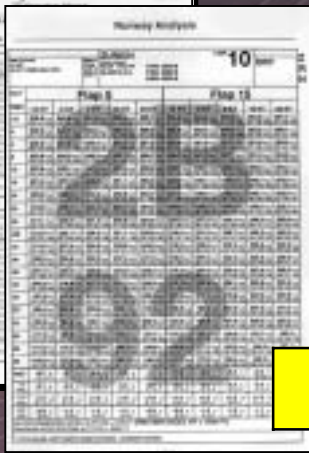
AND/OR

NSS – 2004/5

- Datalink Comms
  - SATCOM
  - Gatelink
  - CPDLC
- NOTAMS
- Weather
- Video Recording
- Data Recording
- Intranet
  - Crew Scheduling
  - E-Mail
- Security
- Expandable
- Supports Maintenance
  - Fault Reporting

SIU

NSU

CWLU

TWLU

Support addition of ARINC 763 Network Server System

Boeing & Jeppesen will provide Applications that support Portrait or Landscape systems

Airborne Communications Capability

- Today, once the airplane is airborne, communications with dispatch or Airplane Ops Center (AOC) is limited (e.g. ACARS/VHF)

- Future CNS/ATM functionality may not be supported

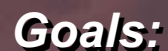- Passengers often have better access to modern communications than the crew

Goals:

Short term: provide airlines with effective tools to communicate efficiently to flight and cabin crew when airborne, e.g. Company intranet, scheduling, fault reporting, etc.

Long Term: Facilitate CPDLC (Controller / Pilot Datalink Communications)

Surface Ops/Ground Navigation

- *Today,* some cars have better access to ground navigation than airplanes

- Airplane design has traditionally focused on Airborne Navigation

Goals:

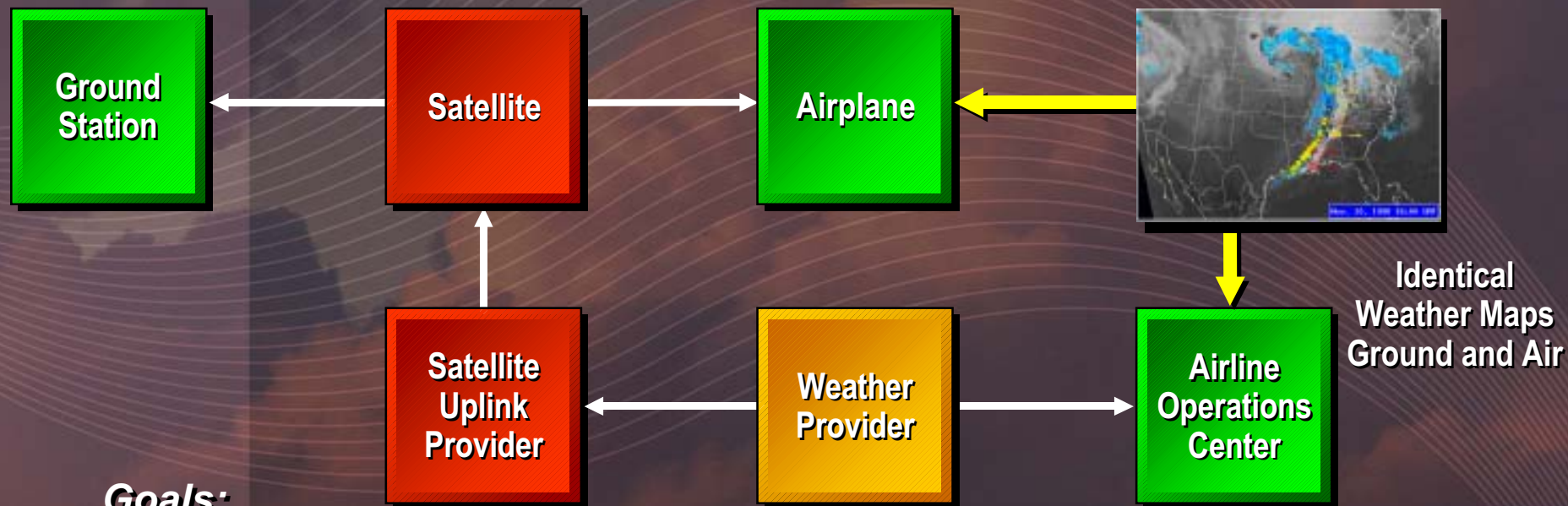*Short Term:* Provide Taxi Map Displays for Situational Awareness

Long Term: Incorporate NOTAM updates and route information

Weather Information

- *Today*, flight crews have limited access to real-time weather

Proof of Concept Operational Program
AWIN Trials – Charts, Weather

```
Ground          Satellite          Airplane
Station                                 ↑

Satellite  ←    Weather    →    Airline
Uplink          Provider         Operations
Provider                          Center
```

Identical Weather Maps Ground and Air

Goals:

Provide flight crews access to weather information currently available only on the ground

Facilitates better decision making and potentially reduced fuel burn

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Application Manager- overview

- **Provides the following system functions:**

- **Pilot Access**

  - **Primary Pilot Interface control and top level application navigation management**

  - **Dedicated one touch bezel function key**

  - **View Transfer (DU to DU)**

- **Maintenance Access**

  - **Software loading interface**

  - **System Utilities**

  - **Software configuration control**

  - **BIT/BITE**

  - **Maintenance diagnostics**

Application & System specification subject to change

Video Surveillance - overview

COCKPIT DOOR

Initial deployment*

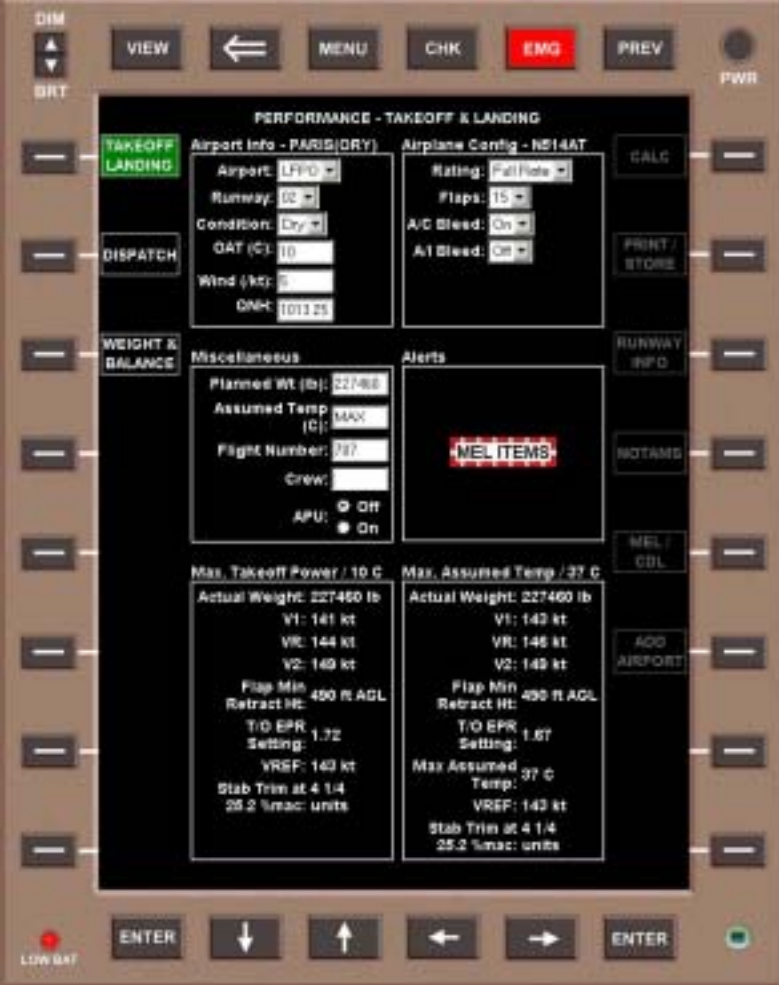• **Allows pilots to view flight deck door area from seated position**

  • **Identify person at the door**

  • **Ensure nobody else within 8ft radius**

• **Displays located in forward field of view**

• **Split screen images for multiple camera viewing**

• **Airline selects number and location of cabin cameras**

Future Options*

• **Potential to record images during flight for later retrieval**

• **Datalink images off-board**

* Contingent upon additional hardware options

Onboard performance tool - overview

- **Compute takeoff and landing performance**

  - **Calculates limit weights, V speeds, and engine power settings based on user input of airport conditions, and airplane configuration**

  - **Calculates assumed temperature thrust reduction for operations below limit weights**

  - **Accounts for MEL & CDL items and affecting aircraft performance**

  - **Accepts input of NOTAMS which alter airport definition (e.g. runway shortening, temporary obstacles)**

- **Facilitate Weight and Balance calculations**

  - **Verifies CG within limits based on user input of passenger, cargo and fuel load**

  - **Calculates stabilizer trim settings**

Electronic documents - overview
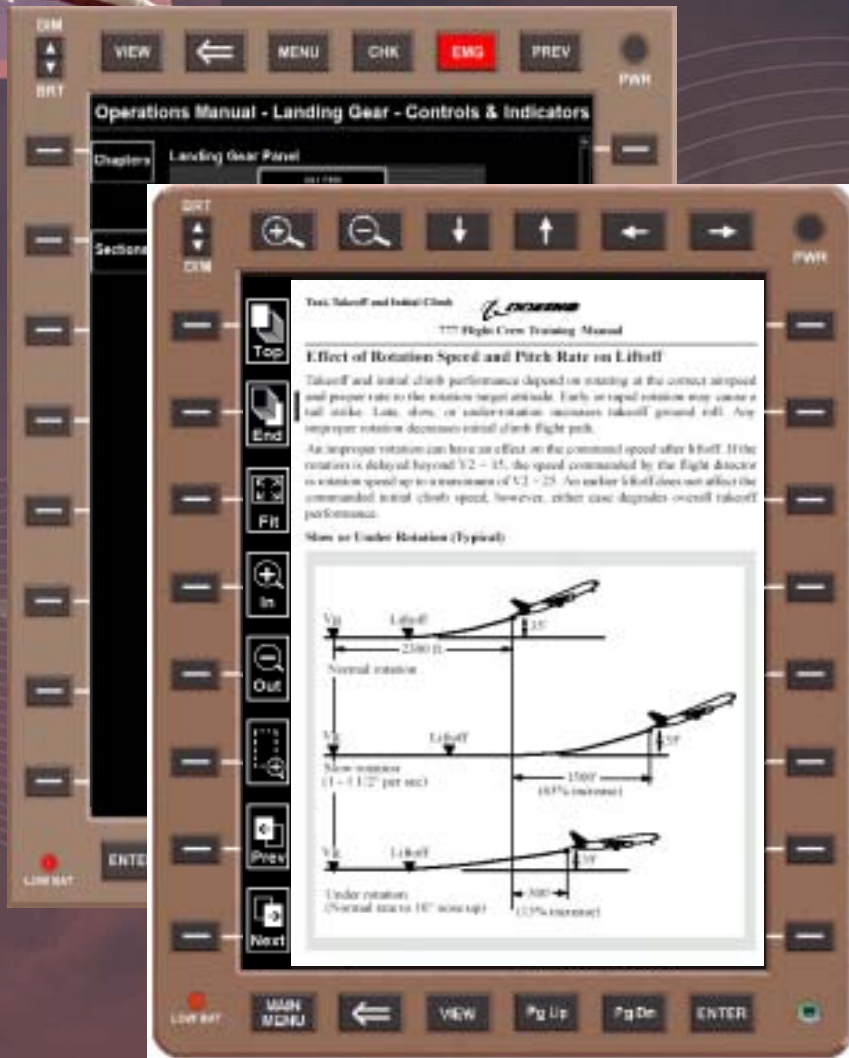
- Display PDF, HTML, XML documents
  - allow for integration between manufacturer supplied and airline authored documents
  - "smarter" formats (XML) provide best document display control
- Provides links between documents and document navigation using hypertext
- Text search engine
- Typical documents
  - Flight Crew Operations Manual
  - Flight Crew Training Manual
  - Minimum Equipment List
  - Airplane Flight Manual
  - Flight Planning & Performance Manual
  - Airline Policy Manuals
  - etc.

Electronic logbook - overview

- **Record basic flight information (crew members, flight times, weight and balance, fuel uplift, etc.)**

- **Record fault reports using pilot friendly graphical interface (electronic FRM)**

- **Provide flight crews with airplane status**
    - **deferred maintenance items**
    - **information on recurring faults (fault history)**

- **Record completion of non-routine (fault resolution) and routine maintenance action (servicing, scheduled checks)**

- **Work management tool for line mechanics**

- **Record airworthiness release**

- **Feed enterprise resource planning (ERP) databases**

- **Provide compliance with regulatory record-keeping requirements**

Application & System specification subject to change

Taxi Moving Map - overview

- **Improved Situational Awareness**

- **Own airplane position only**

- **New dedicated airport databases**

- **Consistent accuracy over entire airport surface**

  - **3-5 meter accuracy maps**

- **Pilot selectable North-Up or Heading-Up modes**

- **Individual zoom and Pan functions**

- **Text remains readable during map rotations**

- **Each taxi segment individually labeled**

Navigation Charts - overview

- **Electronic Terminal Area Charts**

  - •**Content:**

    – **Jeppesen standard**
    – **Jeppesen tailored**
    – **Terminal charts (SIDs, STARs, Approach, Airport, noise & airspace)**

  - •**Enhanced interface**

    – **Quicker access to charts**
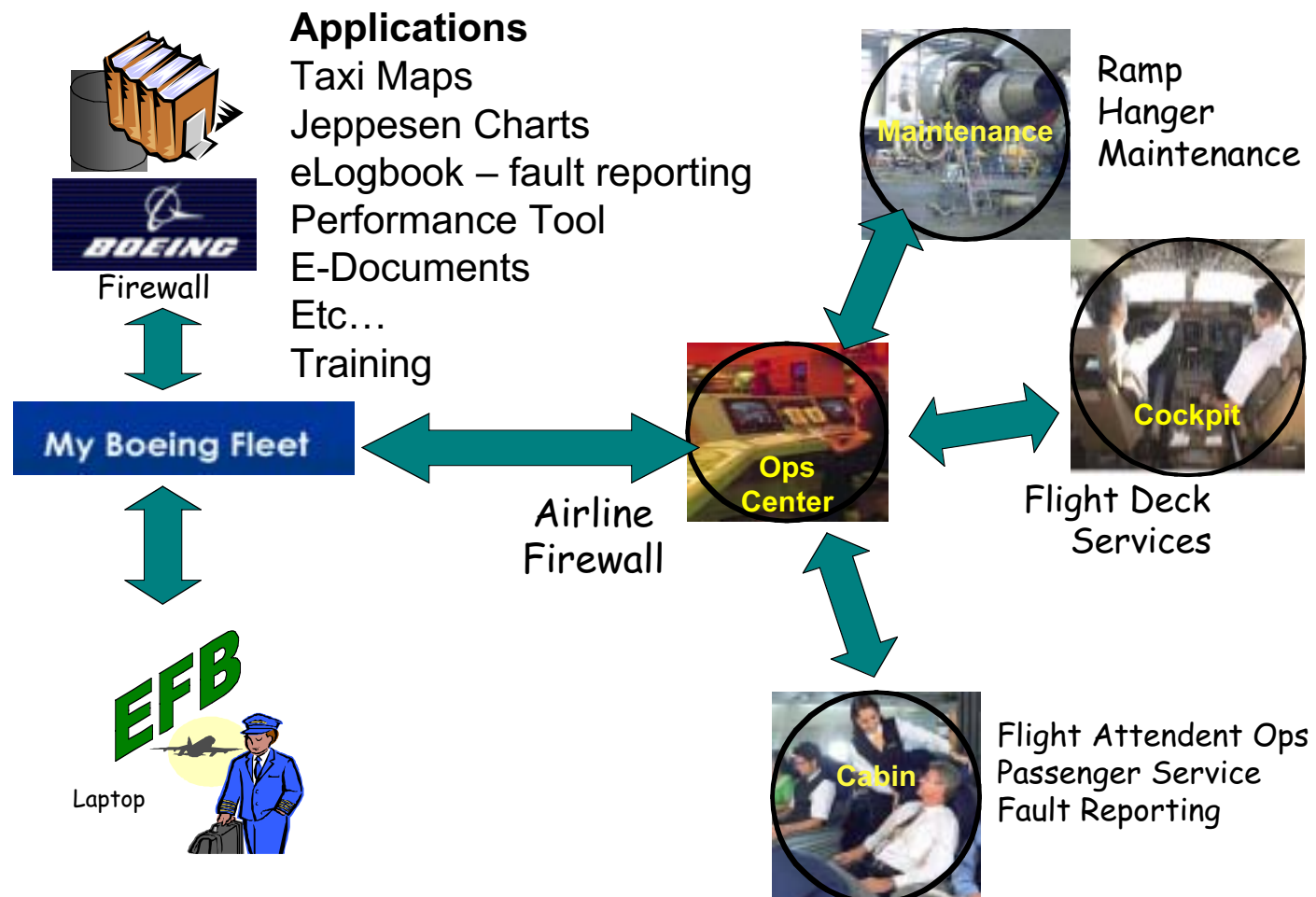   – **Pre-loading from FMS flight plan (where possible)**

  - •**Format**

    – **Vector-based**

- **Airport Familiarization Charts**

  - • **familiarization prior to arrival**

  - • **Individual Pilot selectable views**

  - • **CBT**

Data Distribution using Secure Internet

Crew Information Systems Data Distribution

Applications
Taxi Maps
Jeppesen Charts
eLogbook – fault reporting
Performance Tool
E-Documents
Etc…
Training

Firewall

My Boeing Fleet

Airline Firewall

Laptop

EFB

Ops Center

Maintenance — Ramp Hanger Maintenance

Cockpit — Flight Deck Services

Cabin — Flight Attendent Ops Passenger Service Fault Reporting

How Do We Implement EFB?

Rules and Regulations

- FAA has recently released a EFB Advisory Circular

- AC 120-76 defines EFB's in 3 separate classes

- Certification is divided into:
  - Parts 23 and 25 Airplane Airworthiness
  - Unique requirements for each class

- Operational Approval
  - Parts 91, 135 and 121 Operations
  - Same operational approval applies to *all* classes of EFB

- Human Factors Considerations

How Do We Implement EFB?

Rules and Regulations (continued)

EFB Airplane Certification Criteria

- Structural mountings, environmental, egress, safety

- Non-interference

- Equivalent level of safety must be shown

- Functional hazard assessments required for some applications
  - Data accuracy, integrity, availability
  - Loss of data and Misleading data

How Do We Implement EFB?

Rules and Regulations (continued)

EFB human factors considerations

- Should be considered for all EFB systems

- Part of the TC/SB process for all installed EFB's

- Includes many aspects
  - Human/machine interface
  - Physical components (structural cradle, articulating arms, cabling, connectors, etc.)
  - Responsiveness of application
  - Lighting and readability issues
  - Input mechanisms
  - Managing multiple open documents
  - Critical phases of flight, etc.

- Supporting documents (e.g. Volpe Human Factors guide)

EFB Implementation

777 Flight Deck

* Crew Laptop's updated from server for offboard access

* Optional

External antenna

Terminal wireless transceiver

Captain's fixed display

First Officer's fixed display

Cabin wireless access point

Computer trays in EE-bay

Airplane system interfaces

(ACARS, SATCOM, Connexion, FOQA, flight plan information, Weather etc.)

ARINC 763 Network Server System Architecture

Potential EFB Display Locations

757/767

737 NG

747-400

777

w029g1.24

The Challenges

- Consistent with Flight Deck Philosophy

- Physical constraints for Retro-fit and Production

- Environmental Qualification considerations

- Crew Interfaces

- Lighting considerations

- Crew Workload

- Distractions and Fatigue

Electronic Flight Bags

Summary

- Eliminate paper

- Open architecture

- Basic and tailored applications to meet airline needs

- "Plug and Play" options for efficiency

- Certification - safety, workload and approval

- Integration to avionics and other on board systems

- Flexible, phased implementation to accommodate growth